Forecasting Techniques & Promotional Analysis in Fast Moving Consumer Goods

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SCHOOL OF SCIENCE & TECHNOLOGY

A thesis submitted for the degree of

Master of Science (MSc) in E-Business & Digital Marketing

MARCH 2020

THESSALONIKI – GREECE

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Abstract

This dissertation was written as a part of the MSc in E-Business & Digital Marketing at the International Hellenic University. The purpose of this dissertation is to examine the causes of changing the volume of sales for one specific fast-moving consumer good. We aim to examine the causes by creating a model analyzing the prices, promotions and the volume of sales. The result of this analysis should add value to the marketing campaigns and positioning of this product in the market, in order to attract the biggest market share possible from all the competitors.

I would like to thank my professor Mr. Agamemnon Baltagiannis for the guidance and support and my good friend Manos and my family, for all the help and understanding.

Maria Adamidou

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Contents

1 Introduction

Nowadays, we live in the era of information. Everything we do in our everyday lives is connected with data and information. This creates high expectations in every aspect of a person's routine, from the way he works to the way he sleeps. Obviously, data and information are very important to the consumers and the retailers as well. Consumers with access to technology, have access to which price everybody sells a specific product. Anyone who owns a smart-phone can instantly compare products from all around the world and choose the one that perfectly fits his needs.

Furthermore, when we are considering the fast-moving consumer goods people can compare only the local providers/ retailers. When thinking of monopolies, the attraction of the customers is easy, as the competition is absent. But when thinking products like milk, that are being sold from different providers in every corner of the city, the attraction of customers is getting more difficult. The retailers need to differentiate themselves in order to keep a healthy business going on. At this point we recognize the importance of the influence that promotional offers have over consumers' behavior. We already know that promotions attract more customers but we need to search deeper in order to understand how the promotions affect consumers' behavior. In other words, through this paper we aim to demonstrate the benefits of the analysis of Price discounts and competitive products for identifying promotional impact, whether these are effective or not.

As the Marketing promotional strategies should lead to an overall category growth rather than cannibalization, the results of the analysis should be able to provide the retailers with insights by which it will be possible to predict the consumers' behavior. As too much or too little promotion could repel the customers and lead them to our competitors. Based on the outcome of the analysis, the retailers will be able to adjust their strategies and marketing policies in more effective ways that will lead them to the overall category growth and the creation and the enhancement of their brand. Furthermore, we will combine information as the time, the promotions, the competitors, so the results will be more precise and individualized for each company.

In this dissertation we begin with the theoretical background, we continue with the data preparation and explanation, data analysis, discussion over the results and finally the conclusion.

2. Literature Review

In this section is being presented the theoretical background.

2.1 Fast Moving Consumer Goods

FMCG are commodities that are being purchased really fast by consumers and on a low price. This category includes products with low duration like beverages, packaged food, OTC (over the counter) drugs. [1][2]
The majority of FMCG have short-term shelf-life. Shelf life is referring to the total of the time period that a commodity stays on the shelf before it will be purchased by a consumer or expired,[3] which occurshigh consumer demand or rapid deterioration.
The FMCG are attracting interest from both consumers and marketers.
From the consumers point of view FMCG are cost effective, easy to consume and they have low engagement as they are easy to choose. For the marketers FMCG are being sold in large volumes and they have low profit margins.
Profit margin is an indicator of a company's pricing strategies and how well it controls costs. Differences in competitive strategy and product mix cause the profit margin to vary among different companies.[4] As there are plenty of daily offers and promotions apropos the fast-moving consumer goods from all the brands, for example get one bay one for free, it can be really difficult to cause repeated purchases.

2.2 Promotional Analysis

“Promotional analysis is a result of human behavior analysis.”
The new technologies (e.g. GPS) allow companies to create campaigns based on the location of the potential customers and target them by applying their promotions when the customers are already nearby and, in a mood, to purchase. [5]

Over the years retail companies have noticed that offering discounts over a product increases the possibility that a customer will actually buy this product and this is more likely to lead to a total sales increase.[6] 10 to 45 percent of the total revenues is caused by the promotions in retail companies. Additionally, 20 to 60 percent are actually increasing the margins and the rest, they just do not accomplish enough sales so

as to be beneficial for the company.[7] This is happening due to the retailer's inability to understand and analyze all the factors of promotional analysis.[8]

2.3 Elasticity

An important measurement in promotional analysis is the Elasticity. Elasticity shows how an economic variable responds when another one is being changed. Specifically, the elasticity in price shows how much the sales would increase if the price of a product was reduced by a specific percent.

The importance of elasticity is found in indirect taxation, the distribution of wealth and in the theory of consumer's choice. "Elasticity is also crucially important in any discussion of welfare distribution, in particular consumer surplus, producer surplus, or government surplus."

Elasticity is a well-known tool because it is not dependent of units and that clears up the data analysis.

2.3.1 Elastic -Inelastic variables

Elastic variables (E>|1|) are the ones that correspond equally with the changes that are happening to other variables. On the other hand, inelastic variables (E<|1|) are the variables that correspond less than proportionally with the changes that are happening to other variables. It is usual for variables to have different elasticity values at different points. For instance, the quantity of a product could be inelastic at high prices while it could be elastic at low prices. This means that an increase in the low prices would occur, a more than equal change (increase) in quantity. At the same time an increase in the higher prices would lead to a less than equal (decrease) in quantity.[9]

2.3.2 Elasticity of Supply - Demand (Cross elasticity)

"In economics, the cross elasticity of demand or cross-price elasticity of demand measures the responsiveness of the quantity demanded for a good to a change in the price of another good, ceteris paribus."

Cross elasticity is a percentage, which counts the effect of the change that happens in the quantity of good-A compared to the change that happens on the price of good-B. For instance, when the price of milk rises by 10% the demand for cereal drops by -5%. This equals with -5%/10%= -0,5. An increase in the price of milk occurs a decrease in the demand of cereal. When the cross elasticity is negative (<0), that indicates that the products are complements and when the cross elasticity is positive (>0) it is indicated that the products are substitutes.

Furthermore, when the good-A & B are complements, the rise in the price of good-B causes a decrease in the quantity demanded for good-A. Equally, when the price of good-B decreases the quantity demanded for good-A increases. In the case of substitute products applies the opposite theory.[10]

2.4 Competition

"The effort of two or more parties acting independently to secure the business of a third party by offering the most favorable terms" is the definition Merriam-Webster have given to business competition.[11] The distribution of the fruitful resources to the most valuable uses in order to further strengthen the competences [12]

The separation between perfect and imperfect competition was later introduced by microeconomic theory. This separation resulted, with the conclusion that there is no more fruitful type of allocation than the perfect competition. Competition is the reason why companies create new services, products and technologies. These new products, services and technologies are aiming to give variety and better options to the consumers. The variety caused by competition usually results in lower prices for the services and the products, when compared to those if there was no or little competition. On the other hand, competition could result in duplicated efforts or higher costs.

There are some considerations about the level of effectiveness of competition in regards to profitability. Actually, there is the belief that the companies tend not to be profitable when they are competition oriented. This occurs from the fact that competition is being a restrictive factor when there is a need for innovation in the firms' reactions due to market changes [13]

2.4.1 Three Levels of Economic Competition

Three levels of economic competition have been classified as:

When talking about *brand competition* we refer to the direct competition between commodities that have the same use/function. An example to the brand competition would be the car companies. In this case there has been noticed that if one company adds a new product then the competitor, will distribute the same new product as a reaction to the competition.

Furthermore, *substitute competition* refers to the indirect competition between products that have similar use/function. For instance, butter and margarine are competing with each other.

Last but not least is the budget *competition*. This category includes all the possible products a consumer can purchase with his/her money. A college student, for example, has 2,000€ to spend on various products. All the possible products that he/she could buy are competing with each other e.g. clothes, shoes, books, concert tickets.

It is a fact the competition exists between firms. Competition often exists within firms too. Internal competition is the term for this kind of competition which was first presented by Alfred Sloan in the 1920's.

Alfred Sloan, a business executive at General Motors, was the first to purposely introduce areas within a company that cross each other and raised the competition between the divisions. In the automotive industry this resulted in creating parts in one division that could be shared and used by other divisions too.

It is very often the fact that competition in many countries is eliminated or even restricted by law. Legal restriction derives from governmental monopoly or government –granted monopoly. Another way to prevent competition on behalf of the governments is the bonuses, taxes and other guarding standards.

It is clear that competition is dependent to each competition policy and is being regulated on a higher or lower level from the law. Another case relative to that is the lower competitive businesses are being commenced because of the higher governmental laws, through the "discovery process". [14]

2.4.2 How to spot your competitors?

Competitors' identification and understanding are vital for businesses and their operations. Identification is the first step to competitors' analysis. As companies do not, or should not, analyze all the companies, but only those that they identify as existing or potential competitors. Additionally, competitor identification establishes the boundaries and the structure of the market.

In the literature we have found two approaches for competitor identification. The first approach is called *supply-based*. In this approach the competitors are being identified based on the similarities of technology, strategy, products. The second approach is called *demand-based.* In this approach the classification is based on the attributes of customers. Specifically, attitudes and behavior of customers are the most important aspects of this approach and have been an important area for the marketing research.[15]

2.5 Marketing Mix

The concept of the Marketing Mi was firstly introduced by Neil H. Borden. Borden referred to Marketing as a form of art and he established the twelve elements that need to be managed in order to have a profitable firm.

Later, Jerome McCarthy eliminated these elements from twelve down to four, Product, Price, Place and Promotion.

In our analysis we focus on the price and the promotion.

As aforementioned, what interest us are the changes in the volume of sales caused on the price changes of a product.

"Volume of sales" is referring to the units of a product that have been sold on given time period.

2.5.1 The Marketing Mix and the Consumers Behavior

Nowadays, consumers are more involved and better informed in the purchasing procedure. This is the result of the unlimited access that consumers have in data bases, information and online marketplaces. The need to change from mass marketing to personalized marketing is getting greater day by day. Furthermore, marketers need to

dialog more with the existing and potential customers in order to able to apply personalized techniques. This communication will allow marketers to identify the customers' needs quickly so as to react accurately and on time. [16]

2.6 Promotion

Promotion is the tool that makes the offers/discounts known to potential customers. The purpose is to attract as many customers as possible. Furthermore, in the term 'promotion' are included the advertisements, the marketing and the most important element to our analysis, the discounts and sales of the product. [17]

2.7 The Brand

From the beginning of time retailers used their brands in order to differentiate their products. In our days we understand the importance of the brands from the legal protection that comes through trademarks, copyrights and patents. Also, the way the products are being differentiated based on the brand is almost as important as they are differentiated based on physical characteristics like size, color. [18] Branding is to maintain the combination of characteristics that distinguishes the product from other similar ones, attracts more customers and adds value both to the retailer and the consumer. [19] The brand is the identity of the product, is the way that the consumer can recall this specific product, after the first contact, for future purchases. [20] The customers' decision-making process can be highly influenced from the a weak or a strong brand. The stronger the brand the higher the returns to the companies. [21] Branding helps to increase awareness and the engagement level with the consumers worldwide. [22]

2.8 Cannibalization in Marketing

Cannibalization in Marketing is being defined as "*The process by which a new product gains portion of its sales by diverting them from an existing product*" [23] Cannibalization theory is based on the substitute products. Substitutes are two products that if the price of the one rise that leads to the rise of the demand of the other product (e.g. Coca-Cola & Pepsi), as already mentioned in part 2.3.2 of this paper. The cannibalization phenomenon has occurred from the tendency consumers have, switching between products when there is a lower price or better promotion of the product (like

the placement in the shop). From the retailers' point of view this means that the rise or decrease in the demand of their product occurs from the other promoted products. So, when analyzing the performance of a product, the promotions of other similar products should also be taken under consideration.

3 Data Analysis

3.1 The Dataset

The dataset consists of 146 weekly data. The date includes information regarding the volume of our sales of one specific product, the base price, the actual price, the percentage of the promotion we have applied, the price that our 7 competitors sell and the type of the promotions.

The actual price is between the ranges of 0,758 and 1,222. The base price has values of range 1 and 1,222. The promotions that we apply on the products are from 0% to 35,2%. The types of promotions are A, B, C, D, E, or null. Regarding the prices of the competitors the lowest was 0,255 by Competitor 3 on week 36 and the highest was 1,414 by Competitor 4 on week 113.

The prices our competitors are selling are always lower than the actual price (our price) with an exception of the Competitor 3, who is always selling with higher price than we do. Another also interesting fact is that Competitor 3 joined the competition no earlier than the week No 87.

Furthermore, as the aforementioned Competitor 3, competitors 2, 4, 5, 6 & 7 are not selling constantly during the 146 weeks, only competitor No 1 appears throughout the whole period. Competitors 4 & 5 are joining competition on week No 14, Competitor 2 on week No 68, Competitor 7 on week No 120 and Competitor 6 on week No 122. It has been also noticed that between weeks 124 and 141 all of the competitors are performing at the same time.

This element is of a major importance as in our model we use training dataset and the results could be misleading. Another very important outcome of this observation is that the competition is getting stronger as the time passes, which leads to different factors influencing our volume of sales.

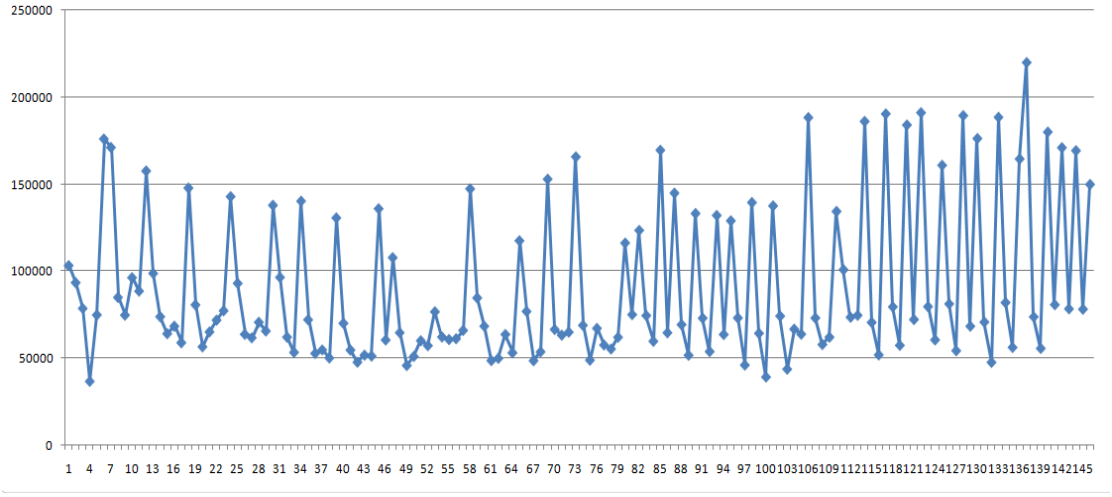

Chart 1: Volume of Sales over the 146 weeks

In Chart 1 we observe how the volume of sales changes over the weeks. At the first glance we can notice the seasonality affecting the volume of sales. An interesting observation is that during the weeks where the competition exists with all of our 7 Competitors performing at the same time (weeks 124 -141) our volume hits the heist peaks.

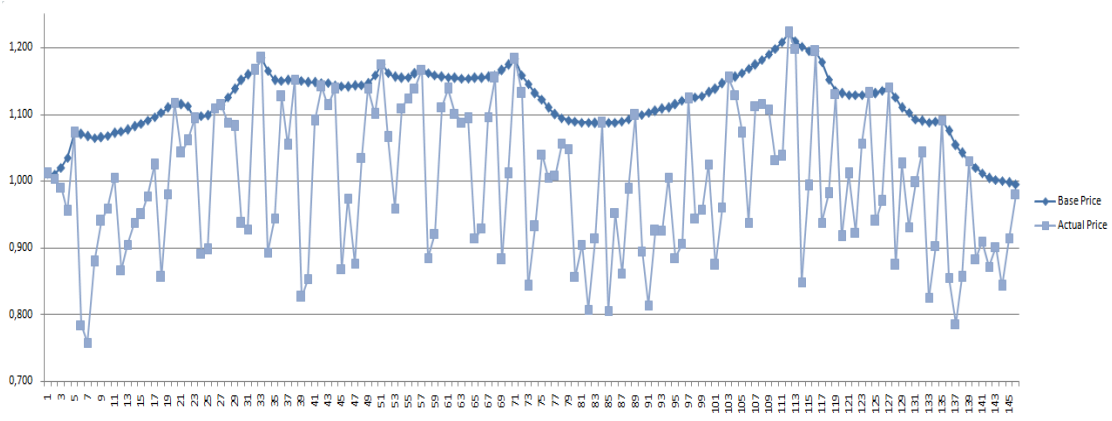

Chart 2: Actual Price (dark blue) Vs Base Price (light blue)

By observing Chart 2 we see that most of the time, we sell with the actual price which is lower than the base price. That occurs from the promotions we apply. When the light blue is same as the dark blue, there are no price promotions available.

Combining Chart 1 and Chart 2 we come to the conclusion that the volume of sales rises because of the promotions we offer in regards with the price. At this point is difficult to separate the seasonality from the promotions as cause to the rise in the volume of sales.

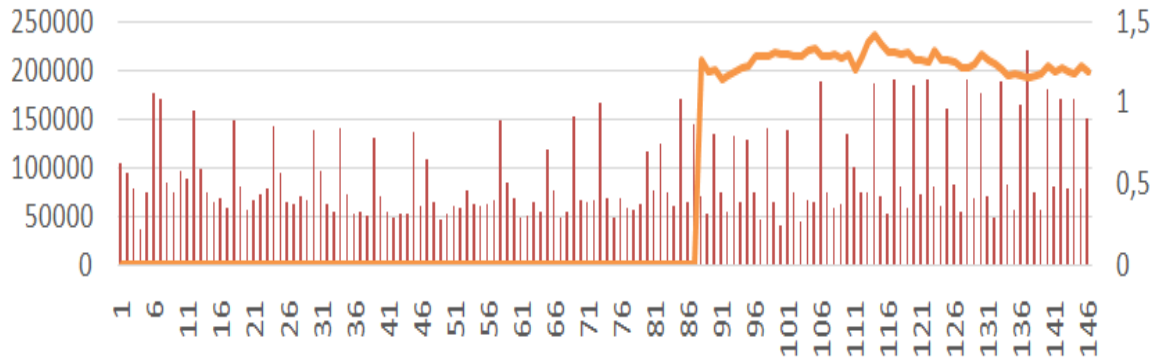

Chart 3: The actual price, the base price & the price of the Competitor 3

In Chart 3 we can see the difference on the prices between us and the Competitor 3. As mentioned above the Competitor 3 is the one that sell constantly on higher prices than we do and higher than the base price. Combining Chart 1 and Chart 3 we can clearly notice the cannibalization effect from week 87 and onwards. From the week 87 we have reached the highest levels in the volume of sales. The majority of the lower points on this period are also higher than the period before the week 87. The observation here is that Competitor 3 is being cannibalized from us, considering that consumers are buying on the same pace.

3.2 The model

In this part we will be discussing the details about the model we have created.

Initially we have prepared our data in excel.

The original set included:

Column 1 – Week

Column 4 – Volume of Sales

Column 8 – Actual Price

Column 11 – Base Price

Column 12 – Percentage of Promotion

Column 13 – Competitor 1 Price

Column 14 – Competitor 2 Price

Column 15 – Competitor 3 Price

Column 16 – Competitor 4 Price

Column 17 – Competitor 5 Price

Column 18 – Competitor 6 Price

Column 19 – Competitor 7 Price

Column 27 – Promo All (1-0)

Column 28 – 32 Type of promotion (1-6, 6=no promotion)

We have created the below in order to help usto build our model:

Column 2–Week Seasonality

Column 3 – Year seasonality

Column 5 – The absolute volume of sales from week to week

Column 6 – The percentage of volume from week to week

Column 7 – Flag Volume >50.000

Column 9 – Actual absolute week to week

Column 10 – Actual percentage week to week

Column 20 to 26 – Change in the prices of the competitors from week to week

Column 33 – Consecutive week of promotion

We have calculated these extra variables in order to examine how the changes in prices, promotions and time are affecting the volume of sales. We believe that those factors are of high importance in regards with the change in the volume of sales. The hypothesis is that the comparison between actual price and the base price are playing a lead role in the volume of sales.

As the goal of this paper is to create and analyze a prediction model with the already existing data, we have created the variable of the difference between the volumes of the sales of the 2 previous weeks (absolute & percentage).

Additionally, we have set, randomly, the 50.000 units sold from the previous week as another variable that could affect our future sales.

In order to test whether the promotions are affecting the volumes or not, we created the consecutive week of promotion, which calculates if the promotion running this week was also running on the previous week. Also, we have added the types of promotions in order to find out which promotion creates the highest volume.
As discussed earlier, seasonality has a high probability on affecting the sales, based on theory. For this reason, we have added the seasonality in our model.

Moving forward, we trained our dataset with the 80% of our data as training set and the 20% as the test set. Finally, we have created a simple linear regression model in order to find which factors are the more significant in influencing the volume of sales.

The results of the linear regression are as shown in the Appendix 1.
Based on the first table we understand which of the coefficients are more important than the others.

Significance . 0.05
We will start by analyzing the coefficients with the minor importance. First, we have the “Volume per week to week” with importance 0.01. This means that the difference between the volumes of sales, of the last 2 weeks (how the volume changes) could affect the volume of sales of the next week.

Significance * 0.01
The next coefficient is the week with importance of 0.05. Here we get the information that the volume of sales is being influenced from the week which leads to the seasonality. As aforementioned in chart 1 regarding the seasonality, the results agree with our initial hypothesis.

The promo per week is the following coefficient with similar importance, which means that if there is a promotion of any kind available that would increase the volume of sales.
Another coefficient with the same importance is the actual price per week, which shows that the price we are selling our product affects positively the volume of sales while the base price coefficient is of minor importance. The outcome of these results so far, could be that the consumers are not actually influenced by getting the best discount possible. It shows that the consumers are attracted to the general idea of promotion (e.g. advertisements)
The next coefficient is very interesting as it refers to the Competitor 3. As we have mentioned before in the explanation of the data, Competitor 3 is always selling on a higher price than we do. The assumption here could be the customers are comparing us with competitor 3 more than they are comparing us with other competitors. As we sell on lower prices customers tend to prefer us.
Additionally, the consecutive week is significant in our model, which means that the volume of sales is increasing when there are promotions for the product for more than 2 weeks consequently. We understand that it is more effective to promote our product constantly than promoting with time breaks in between.

Significance ** 0.01
The coefficient “Flag for volume > 50.000” is the first of this level of significance. The information we get here is the if the volume of sales of the previous week is higher than 50,000 then for the next week, we expect lower volume, as the estimation is negative. Moving forward, the other variable with the same significance is the Type C promotion.

Significance *** 0
Following, we will compare all the promotional types together as all of them come with a level of significance. Promotions’ type D and type E are of similar significance with the promotion type E being a little more important. The promotion type C has significance 0.01 while type A &type B are of the greatest significance in our model, which is very close to 0.The information we get here is that between the types of promotions A, B, C, D & E, types D and E are less likely to increase the volume of sales

than the other three. Also, type C is more likely to affect positively the volume of sales than types D & E, while types A & B are the most likely to affect the volume of sales than any other coefficient in our model.

The business strategist here should take under consideration all the coefficients and focus on the more significant ones. For example, the strategist should combine 2 or more significant coefficients and observe the results on the volume of sales. An example would be to offer promotion type A and type B on 4 consecutive weeks or promotion type C during the seasonal weeks.

In Appendix 2 we see the correlation between the actual volume of sales and the predicted volume of sales. The 83% shows strong relationship between these two variables. Also, the min max accuracy is at 73%, which is a good percentage close to 1, showing that the error of our model is low (Mean Absolute Percentage Error = 27%). The resume is that the model has a 73% probability of forecasting the volume of sales for the next week correctly.

In Appendix 1 the multiple R-squared shows again the relationship between the actual volume of sales and the predicted volume of sales, with a percentage of 84, we come again to the same conclusion of a strong relationship.

In Appendix 4 we observe that our model is working well till the week 128 and then the errors are getting bigger. We considered that if our training data were less than the 80% there is a probability of our model producing lower errors.

3.3 The pros and cons of the model

Initially this model was chosen because of its simplicity. It would easily serve our cause, to analyze our data and produce results too discus over the promotions and how competition affects the volume of sales. Our thought in regards with the model, from a theoretical point of view, is that all the work is based on the data. The most important element over this analysis is the preparation of the data and the creation of the coefficients. The con of our analysis was the size of the data as we believe that with more data the results would be of a higher importance. Additionally, it is not possible

to make prediction using future data, so we have to be very careful with the coefficients we chose to use.

4 Conclusion

On this paper we have analyzed the SAP data set regarding one product (FMCG). We chose a linear regression model as it can provide us with many elements that can be deeply analyzed and produce hidden knowledge. For additional research, as our interest is on the business level, we could analyze more specific variables like position of the shop selling the product within a region and compared to the position of the competitors (accessibility). Another interesting factor would be the variety that each shop provides and the possible stock. All this knowledge could add great value to the strategy of each company, in terms of marketing, logistics, as well as in terms of which products it should decide to sell so they can increase the volume of sales.

5 Appendix

```
Call:
lm(formula = VOLUME_OF_SALES ~ Week_season + Year_season + Volume_per_week2week +
    Flag_vol_50000 + BASE_PRICE + ACTUAL_PRICE + Promo_per +
    Actual_per_week2week + COMPETITOR1_PRICE + COMPETITOR2_PRICE +
    COMPETITOR3_PRICE + COMPETITOR4_PRICE + COMPETITOR5_PRICE +
    COM_1_week2week + COM_2_week2week + COM_3_week2week + COM_4_week2week +
    COM_5_week2week + TYPE_A + TYPE_B + TYPE_C + TYPE_D + TYPE_E +
    cons_week, data = train_data)

Residuals:
   Min     1Q Median     3Q    Max
-42199  -9575    282   8039  42179

Coefficients:
                    Estimate Std. Error t value Pr(>|t|)
(Intercept)          76185.8    81654.3   0.933 0.353302
Week_season           -505.1      232.1  -2.176 0.032144 *
Year_season         -11125.1     9907.8  -1.123 0.264480
Volume_per_week2week  -5677.3     2942.4  -1.929 0.056822 .
Flag_vol_50000       -17620.0     5279.0  -3.338 0.001229 **
BASE_PRICE          -205145.2   199804.1  -1.027 0.307298
ACTUAL_PRICE         233457.7   194975.5   1.197 0.234307
Promo_per            348349.7   162301.4   2.146 0.034538 *
Actual_per_week2week -53940.9    26903.9  -2.005 0.047973 *
COMPETITOR1_PRICE    -25297.4    97982.0  -0.258 0.796854
COMPETITOR2_PRICE      6443.2    19612.2   0.329 0.743275
COMPETITOR3_PRICE     19992.8     9091.1   2.199 0.030429 *
COMPETITOR4_PRICE     18732.1    23317.2   0.803 0.423885
COMPETITOR5_PRICE    -12945.2    14613.0  -0.886 0.378048
COM_1_week2week      -10884.5    42404.5  -0.257 0.798009
COM_2_week2week      -16674.8    16999.8  -0.981 0.329279
COM_3_week2week       27420.3   105659.7   0.260 0.795830
COM_4_week2week       17663.9    14376.9   1.229 0.222413
COM_5_week2week      -14145.2    15939.4  -0.887 0.377207
TYPE_A                31305.0     8612.2   3.635 0.000462 ***
TYPE_B                26274.9     7361.3   3.569 0.000577 ***
TYPE_C                20046.3     6066.1   3.305 0.001366 **
TYPE_D                15051.8     7152.5   2.104 0.038132 *
TYPE_E                18491.3     8238.1   2.245 0.027244 *
cons_week             -8905.9     3939.8  -2.261 0.026201 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 16950 on 90 degrees of freedom
Multiple R-squared:  0.8432,    Adjusted R-squared:  0.8014
F-statistic: 20.17 on 24 and 90 DF,  p-value: < 2.2e-16
```

Appendix 1

```
> min_max_accuracy <- mean(apply(actuals_preds, 1, min) / apply(actuals_preds, 1, max))
> correlation_accuracy
            actuals predicteds
actuals    1.0000000  0.8329507
predicteds 0.8329507  1.0000000
> min_max_accuracy
[1] 0.7384026
> mape
[1] 0.2655996
```

Appendix 2

```
Model = lm(VOLUME_OF_SALES~
        Week_season+
        Year_season+
        Volume_per_week2week+
        Flag_vol_50000+
        BASE_PRICE+
        ACTUAL_PRICE+
        Promo_per+
        Actual_per_week2week+
        COMPETITOR1_PRICE+
        COMPETITOR2_PRICE+
        COMPETITOR3_PRICE+
        COMPETITOR4_PRICE+
        COMPETITOR5_PRICE+
        COM_1_week2week+
        COM_2_week2week+
        COM_3_week2week+
        COM_4_week2week+
        COM_5_week2week+
        TYPE_A+
        TYPE_B+
        TYPE_C+
        TYPE_D+
        TYPE_E+
        cons_week, train_data)
print(Model)
summary(Model)

set.seed(100)
Predictions <- predict(Model, test_data)
```

```
actuals_preds <- data.frame(cbind(actuals=test_data$VOLUME_OF_SALES, predicteds=Predictions))
correlation_accuracy <- cor(actuals_preds)
min_max_accuracy <- mean(apply(actuals_preds, 1, min) / apply(actuals_preds, 1, max))
mape <- mean(abs((actuals_preds$predicteds - actuals_preds$actuals))/actuals_preds$actuals)
```

Appendix 3

week	actuals	predicteds	absolute error	absolute percentage error
118	79548	74582,55	4965,45	6,24%
119	57480	53816,28	3663,72	6,37%
120	183804	144418,5	39385,5	21,43%
121	72300	53483,65	18816,35	26,03%
122	190872	110466,92	80405,08	42,13%
123	79680	40152	39528	49,61%
124	60624	52175,52	8448,48	13,94%
125	160716	122430,68	38285,32	23,82%
126	81216	72369,16	8846,84	10,89%
127	54396	56207,98	1811,98	3,33%
128	189192	158648,92	30543,08	16,14%
129	68436	57885,26	10550,74	15,42%
130	176052	119403,83	56648,17	32,18%
131	70824	75729,91	4905,91	6,93%
132	47760	57527,62	9767,62	20,45%
133	188256	154885,77	33370,23	17,73%
134	82008	68079,11	13928,89	16,98%
135	56304	40119,31	16184,69	28,75%
136	164352	150091,71	14260,29	8,68%
137	219624	123793,88	95830,12	43,63%
138	73788	97087,22	23299,22	31,58%
139	55728	36563,92	19164,08	34,39%
140	179784	120761,61	59022,39	32,83%
141	80772	64517,63	16254,37	20,12%
142	170808	94999,91	75808,09	44,38%
143	78408	47283,36	31124,64	39,70%
144	169092	92974,72	76117,28	45,02%
145	78192	47621,52	30570,48	39,10%
146	149748	41234,78	108513,22	72,46%

33448,97345	**Mean absolute error**
26,56%	**Mean absolute percentage error**

Appendix 4

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